5.1 Energy and Work

I. Energy - an agent of change
- A. Energy has traditionally been defined as the ability to do work
  1. Energy is now thought of as the ability to cause change

II Kinetic Energy (KE): On the Move
- A. Generally when you think of energy you think of motion
  1. This is kinetic energy, energy in motion
     a. The greater the mass of an object, the greater the KE

III Potential Energy: Ready and Waiting

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- A. Energy doesn't have to involve motion
- B. This is stored or potential energy
  1. This often involves gravity; an object above the ground has PE (Potential Energy)
  2. The higher an object, the more more gravity effects it
     a. The greater the force of gravity, the greater the P.E.
     b. There are other forms of P.E. (springs)

IV What is work?
- A. The transfer of energy is the scientific idea of work
- B. Work is calculated in Joules (J)
  1. Work = force · distance → $W = f \cdot d$
- C. Motion must be in the same direction as the applied force for work to occur

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V Conservation of Energy

A. PE + KE change as motion changes

1. On a swing PE increases as KE decreases and vice-versa

B. This is known Mechanical Energy = Total E

M.E = P.E. + K.E.

C. This is a law of nature, energy is always conserved

a. The law of conservation of energy

VI The Human Body

A. To maintain a healthy weight you must have a balance between energy in take and energy out put

1. For humans, food is our P.E.

a. one calorie = 4180 Joules

b. Every gram of fat = 9 calories of energy

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5.2 Temperature and Heat

I. Temperature

A. Most people associate hot + cold (temperature) with heat, however they are not the same

B. Matter in Motion

1. Matter is made up of particles so small that you cannot see them

a. These particles are constantly moving

b. Everything you can think of is made of particles

2. The faster particles move, the more kinetic energy move

3. Temperature is the average K.E. of particles in a sample of matter

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II Thermal Energy
A. Thermal Energy is the total energy of particles in matter
1. Thermal Energy = K.E. + P.E.
2. K.E. is due to the movement + vibrations of particles in matter
3. P.E. is determined by forces that act within or between the particles
a. The more mass a material has, the more P.E. energy it has
B. Different kinds of matter have different thermal energies
1. This is true, even when mass and temp are the same
C. The thermal energy depends on the total energy available in a system/material

III Heat
A. The thermal that flows from a higher temp. to a lower temperature is heat
1. In most cases heat flows from hot to cooler materials
B. Heat is measured in Joules (J) and involves the transfer of energy
1. Therefore, heat is similar to work

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5.3 Thermal Pollution: Waste you can't see
I. Waste Energy
A. Much of energy in its different forms like mechanical, chemical, electrical, and radiant, or nuclear ends up as waste thermal energy
1. Thermal pollution occurs when waste heat significantly changes the temperatur of the environment

II 2 Points of view on Thermal Energy
A. Power plants use cooling towers (of water to cool H_2O used in industrial work
1. 2 points of view
a. thermal pollution is bad for environment and how industrial centers expel the industrial water can have negative effec on the environment if done improperly
b. → Other point of view → government i over-regulating industrial center and thermal pollu

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5.4 Heat Absorption

I. Specific Heat

A. Certain materials can absorb a significant amount of energy without changing temp. (ex: water)

1. The different specific heats of different substances depend on the chemical make up of substances

B. Specific heat of a material is the amount of energy to raise the temp. of 1 kg of water 1 kelvin

II. Calculating Thermal Energy

A. Changes in thermal energy cannot be measured directly, but they can be calculated

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1. Specific heat can be used to determine changes in thermal energy

B. Equation →

1. Change in thermal energy = mass × change in temp × specific heat
2. $Q = m \times \Delta T \times C \rightarrow Q = (m)(\Delta T)(c)$
3. When ΔT is positive, Q is also positive.
   a. This means the object has increased in temp and gained thermal energy

C. The thermal energy characteristics of complex systems depend on the specific heats of the substances involved and the masses and shapes of systems

Practice Problem

32-g silver spoon cools from 60°C to 20°C

specif heat = 235 J(kg·k)

$m = 32\ kg \rightarrow m = .0320\ kg$

$\Delta T = (60+273) = 333k,\ (20+273) = 293k$

$333k - 293k = 40k$

$Q = (.032\ kg)$

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